

DECLARATION UNDER 37 C.F.R. § 1.132
EXPEDITED PROCEDURE
GROUP 2829
PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Docket No: Q74738

Chen Fung LENG, et al.

Appln. No.: 10/552,046

Group Art Unit: 2829

Confirmation No.: 6904

Examiner: Karen M KUSUMAKAR

Filed: January 9, 2007

For: MULTI-CHIP BALL GRID ARRAY PACKAGE AND METHOD OF MANUFACTURE

DECLARATION UNDER 37 C.F.R. § 1.132

MAIL STOP AF

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

I, Anthony Sun Yi Sheng, hereby declare and state:

THAT I am a citizen of Taiwan;

THAT I have received a Doctor of Philosophy (PhD) in Mechanical Engineering from University of Washington, a Master of Science degree in Mechanical Engineering from the University of Iowa and a Bachelor of Science degree in Mechanical Engineering from the National Sun Yat-Sen University of Taiwan.

THAT I am an employee of United Test and Assembly Center Ltd., one of the assignees of the present application, and have been working in the field of semiconductor packaging for over 16 years.

THAT I am one of the inventors of the invention disclosed and claimed in the present application. I am also the one of the inventors of 6 issued U.S. patents and 13 pending US patent applications in the field of semiconductor packaging.

THAT I have reviewed the outstanding rejection by the U.S. Examiner in the above referenced application, including the prior art cited and applied in various combinations by the Examiner, including Akram (U.S. Patent No. 6,424,033) and Hoffman (U.S. Patent No. 6,737,750).

THAT none of the prior art references, alone or in combination, teach or suggest the invention as set forth in the currently pending claims for at least the reasons contained below.

1. When you compare the structure of Figure 2 of Akram et al. with an exemplary package of the claimed invention as depicted in Figure 5, there are clear differences between the two structures which are not result of a mere workshop modification.

2. Referring to Figure 2 of Akram, a second BOC chip package (i.e., chip 112 and substrate 114) is mounted onto a base BOC chip package (i.e., chip 12 and substrate 14). The second BOC chip package is electrically connected to the base BOC chip package by solder balls 132. The solder balls 132 additionally provides a stand-off height between the two BOC chip packages so that wire bonds of the second BOC chip package do not get too close to the lower chip 12 and become damaged.

3. Without the solder balls 132, the second BOC chip package in Akram cannot be supported above the base BOC chip package. Even with wire bonds replacing the solder balls, there will still be no support because the thin wire bonds are not mechanically strong enough to hold the second IC structure above the base IC structure.

4. Therefore, if one were to replace the solder balls 132 in Akram with wire bonds, it will not be just a mere replacement job that results in the present claimed invention. Rather a complete redesign of the entire package structure is required.

5. One modification would be to include spacers between the two IC structures. However, including spacers would not lead to the present claimed invention, thereby emphasizing that the present claimed invention is not a mere workshop alteration of Akram.

6. The present invention, as defined in claim 1, provides a secondary IC structure over a base IC structure. The base IC structure comprises a base substrate, a first semiconductor chip and a first plurality of wires. The secondary IC structure comprises a second substrate, a second semiconductor chip, a second plurality of wires and a first encapsulant. The first encapsulant (i.e., encapsulant 421 of Figure 5 of the present application) fills the secondary opening around the second plurality of wires and covering the second secondary substrate face.

7. To enable stacking of the secondary IC structure over the base IC structure, the secondary IC structure is provided with the first encapsulant which, not only protects the second plurality of wires from the environment, but also supports the secondary IC structure sufficiently to prevent the second plurality of wires from contacting the first semiconductor chip. Wire bonding can be performed to provide the third plurality of wires to electrically connect the second substrate to the base substrate. A separate encapsulant (i.e., encapsulant 525 of Figure 5 of the present application) may then provided to cover over the entire secondary IC structure and portions of the base IC structure, if desired, for example to protect the third plurality of wires. Therefore, unlike the solder ball electrical connections 132 of Akram, the third plurality of wires do not provide any form of mechanical support to the secondary IC structure.

8. Akram does not teach nor suggest the use of an encapsulant material to prevent contact between the second plurality of wires with the first semiconductor chip. Referring to Figure 2 of Akram, there is no separate first encapsulant that covers the opening around the wire bonds and the bottom surface of the second substrate. Instead, the encapsulant (grease 22) forms one common mass which covers the second IC structure including the wire bonds.

9. Thus, the present claimed invention is not just a mere replacement of the solder ball connections 132 in Akram with wire bonds, and involves creative designing of the entire package structure to enable proper stacking and electrical connection of two or more IC structures based on the combination of features as defined in present claim 1.

10. Even if the wire bonds are capable of providing the requisite support, there would be no motivation to look to Hoffman to modify Akram to arrive at the present claimed invention. Hoffman uses a support structure 14 to prevent contact between the top die and the bottom die. The support structure can be a conductive path that provides a ground or other reference voltage to a bond pad [see col. 5 lines 60-64]. Hence, if one were to combine the teachings of Akram with Hoffman, one would have been motivated to design a package to include such a support structure with wire bonds to replace the solder balls, and would not arrive at the package structure as defined in present claim 1 which uses the first encapsulant as a form of support and wire bonds for electrically connecting the secondary IC structure to the base IC structure.

11. Referring to the Examiner's comments to arguments a) and b) in paragraph 17 of the office action, even if one were to replace just one solder ball on each side of the substrate opening with wires such that the other solder balls support the substrate, or replace all of the solder balls with wire bonds, there are still challenges in supporting the secondary IC structure above the base IC structure. Solder balls are typically heated or reflowed to form a secured

electrical connection between two components. During reflow, the solder balls will tend to collapse and care must be exercised to control the collapse so that the upper IC structure does not tilt or be brought too close to the bottom chip. In the present claimed invention, there is no such worry as the first encapsulant is formed on the secondary IC structure before mounting onto the base IC structure. Hence, there is a distinct advantage of the present claimed invention over Akram.

12. Referring to the Examiner's comment to argument c) in paragraph 17 of the office action, the Examiner states that "the third plurality of wires can be considered wire 16b, which connects the secondary substrate 14 to the base substrate 10 via chip 16a and wire 20." The Examiner appears to have misunderstood Hoffman. First, element 16b is the inactive surface of the second die 16 [see col. 5 line 65 to col. 6 line 3] and not a wire. Also, wire 20 connects the chip 16a directly to the base substrate 10 and does not connect the secondary substrate 14 to the base substrate 14.

13. Even if element 14 can be interpreted such that portion 14c is the second substrate, portion 14a is the electrical connection between the second substrate and the base substrate, it is clearly a different feature from the combination of the first encapsulant (which supports the second substrate) and third plurality of wires (which electrically connects the two substrates) as defined in present claim 1.

14. The same arguments for claim 1 would also apply for Independent claims 10 and 17.

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I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: Feb 11, 2009

Anthony